

THAT WHICH IS CLAIMED IS:

1. A hybrid microelectronic memory device, comprising:
 - (a) a substrate having a surface, a first region of first work function adjacent said surface, and a second region of second work function adjacent said surface and adjacent said first region;
 - (b) a film comprising redox-active molecules on said first and second regions; and
 - (c) an electrode connected to said film.
- 10 2. The device of claim 1, wherein said first and second regions have work functions that differ by at least 0.3 eV.
3. The device of claim 1, wherein said first and second regions are spaced apart from one another.
- 15 4. The device of claim 1, wherein said film is characterized by the absence of substantial lateral conductivity.
5. The device of claim 1, wherein said first and second regions are doped 20 regions in said substrate.
6. The device of claim 1, wherein said first and second regions are N+ pockets in a p-well substrate.
- 25 7. The device of claim 1, wherein said first and second regions are P+ pockets in an n-well substrate.
8. The device of claim 1, wherein said first and second regions are each stacked vertically on said surface.
- 30 9. The device of claim 1, wherein said first and second regions comprise metal or metal oxides on said substrate.

10. The device of claim 1, wherein said substrate comprises silicon.

11. The device according to claim 1, wherein said redox-active molecules comprise a metallocene.

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12. The device according to claim 1, wherein said redox-active molecules comprise a porphyrinic macrocycle.

13. The device according to claim 1, wherein said redox-active molecules
10 comprise a sandwich coordination compound.

14. A method of storing data, comprising:
(a) providing an apparatus according to claim 1, and
(b) applying a voltage to said electrode to set an oxidation state of said redox
15 active molecules;

and wherein said redox active molecules adjacent said first region include a different oxidation state from said redox active molecules adjacent said second region.

15. A hybrid microelectronic memory device, comprising:
20 (a) a substrate having a surface, a first region adjacent said surface, and a second region different from said first region on said first region, wherein said first and second regions form a structure that depletes minority carriers from said second region;
(b) a film comprising redox-active molecules on said second region; and
25 (c) an electrode connected to said redox active molecules opposite said substrate surface.

16. The device of claim 15, wherein said first and second regions together form a diode.

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17. The device of claim 15, wherein said first region is n-doped and said second region is p-doped.

18. The device of claim 15, wherein said first region is p-doped and said second region is n-doped.

19, The device of claim 15, wherein said first region is n-doped and said
5 second region comprises a metal.

20. The device of claim 15, wherein said first region is p-doped and said second region comprises a metal.

10 21. The device of claim 15, wherein said first and second regions are each portions of a graded p-layer.

22. The device of claim 15, wherein said first and second regions are each portions of a graded n-layer.

15 23. The device according to claim 15, wherein said redox-active molecule comprises a metallocene.

24. The device according to claim 15, wherein said redox-active molecule
20 comprises a porphyrinic macrocycle.

25 25. The device according to claim 15, wherein said redox-active molecule comprises a sandwich coordination compound.

26. A method of storing data, comprising:
(a) providing an apparatus according to claim 15, and
(b) applying a voltage to said electrode to set an oxidation state of said redox active molecules.

30 27. The method of claim 26, further comprising the step of biasing said diode to inhibit reduction of said redox active molecules and increase the retention time of said memory device.

28. The method of claim 27, said memory device having a t_{1/2} of at least 200 seconds.

29. A method of determining the lateral conductivity of a redox-active 5 molecule when deposited as a film on a substrate, comprising the steps of:

(a) providing a substrate having a surface, a first region of first conductivity type adjacent said surface, and a second region of second conductivity type adjacent said surface and adjacent said first region;

10 (b) depositing a film comprising said redox-active molecule on said first and second regions; and

(c) determining the presence of an additional oxidation state from said film due to the presence of said second region of second conductivity type to thereby determine the lateral conductivity of said redox-active molecule when deposited as a film on said substrate.

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30. The method of claim 29, wherein the presence of said second oxidation state indicating the absence of substantial lateral conductivity of said redox active molecule deposited as a film on said substrate.

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31. The method of claim 29, wherein said determining step is carried out by cyclic voltammetry.

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